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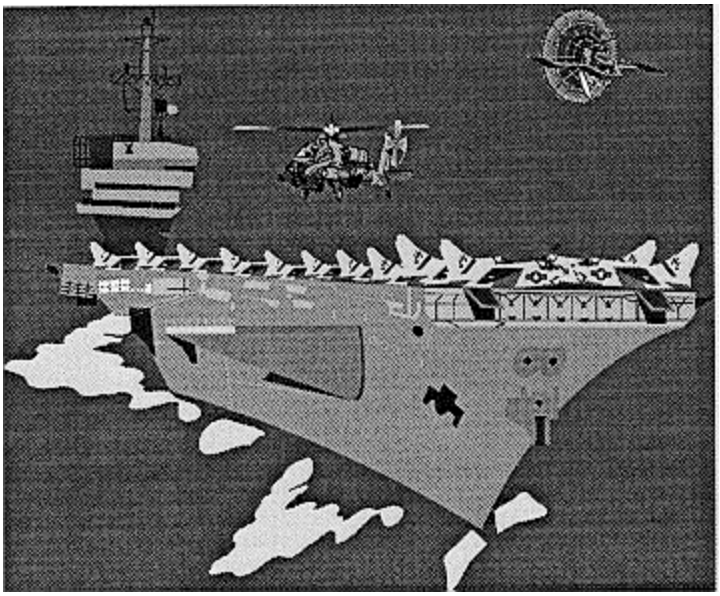


REPROGRAMMING OPERATIONS AT SEA!

What's Inside:

ARMY REPROGRAMMING AT SEA

22,300 miles above the earth in a geo-stationary orbit at longitude 055.00 West, a stabilized one ton communications satellite named INMARSAT-B operates tirelessly and efficiently 24 hours a day...150 miles south-east of Mayport, Florida, a 93,000 ton combat laden carrier, the USS Kennedy (CV-67), ploughs through the pristine waters of the Atlantic Ocean.

USS KENNEDY

Aircrews flying F-18s, EA-6Bs and SH-60F aircraft practice combat flight operations around the clock. On deck, 90 feet above the warm, blue, breaking waves of the Atlantic, stand two USAF electronic combat technicians, MSgts Gary Lang and Chuck Rogers from the USAF Reprogramming Flight in the 68th Test Support Squadron (TSS), Eglin AFB, Florida. They are preparing to demonstrate for the first time, at-sea, over-the-horizon access to the Multi-Service Electronic Combat Bulletin Board System (MSEC BBS). This important combat capability is significant because it permits deployed warfighters from all services to electronically acquire and upload new threat data, (i.e. Mission Data Sets (MDS)) to their Electronic Warfare (EW) equipment.

Sounds like the beginning of a new Tom Clancy techno-thriller, but it is in fact one of the many cost-effective steps being taken by the Army Reprogramming Analysis Team Project Office (ARAT-PO), the Communications-Electronics Command's Software Engineering Directorate (CECOM-SED) and the Night Vision and Electronic Sensors Directorate (NVESD) to speed the uploading of threat MDS to Army Target Sensing Systems (ATSS). Rapidly reprogrammable ATSS now play an important part required in Force XXI and digitization of the battlefield.

Over the years, the US Army (as the lead service for specific light-weight airborne EW survivability systems) has expended significant efforts and assets in the development, production, fielding and maintenance of electronic combat systems for its airborne platforms and those of its sister services. This survivability equipment has progressed from hard wired analog devices, to systems capable of being reprogrammed by changing software threat data. This reprogramming or updating of the

software, although 'expensive', permits improvement and sustainment of the survivability equipment by optimization of its programmed operational and threat information. Reprogramming is the information age alternative to the more expensive and lengthy process of building more and more "new" systems.

A notable (and the most widely fielded) aviation electronic combat system for all the services and many Foreign Military Sales customers, is the AN/APR-39 Radar Signal Detecting Set (RSDS) family. The venerable analog AN/APR-39(V)1 is being rapidly replaced with the digitally reprogrammable AN/APR-39A(V)1/3. Soon to be fielded is the AN/APR-39A(V)2 (primarily for all USMC low-slow, fixed and rotary platforms).

Up until early 1990, the AN/APR-39A(V)1 had only one planned Operational Flight Program (OFP) version number 020.9 and MDS number 017. The changing events of 1990 in the Persian Gulf, military and political developments in other parts of the world, and the fielding of other 'linkable' light-weight EW survivability systems, served to hasten the development timetable. The Program Manager for Aviation Electronic Combat (PM-AEC), CECOM-SED and NVESD set out to formally codify the OFP and MDS required to ensure that the AN/APR-39A(V)1 and its derivatives would be able to accept and process emerging threat changes in different locations. Numerous interim OFP changes to accept interfaces with the AN/AVR-2/2A Laser Detecting Set, AN/AAR-47 Missile Warning Set, a one-way 1553 bus board, and the AN/APR-39A(V)3 receivers were fielded between 1991 and 1995. But the recently fielded and most important OFP (version number 023.9) included the activation of the RS-485 bus within the processor. This set the stage for the Army to do what the other services had been doing for years -- upload or reprogram a MDS at the unit level without establishing a massive and costly logistical effort. In a parallel effort, the Army established the Army Reprogramming Analysis Team-Threat Analysis (ARAT-TA) and collocated it with the USAF 53D Wing at Eglin AFB. ARAT-TA was created to monitor electronic signals and systems worldwide, build more responsive and geo-tailored MDSs, and seek improved ways to program/upload ATSS.

Concurrently, the USAF established its first classified Bulletin Board System (BBS). The BBS would allow its world-wide deployed units with EW reprogrammable systems to 'reach out and touch someone' who was maintaining an encrypted BBS 'stuffed' with MDSs.

To capitalize on all this activity a practical demonstration was required to exploit just how effectively the services have adapted and expanded their reprogramming capability. The US Army quickly joined with the

USAF 68 TSS, part of the 53D Wing, to demonstrate the flexibility and capabilities of the BBS in an expeditionary-type environment. In December of 1995, MSgts Lang and Rogers visited Magnavox in California to learn the operation of the Magnavox INMARSAT B MX 6060 Portable Satellite Phone with the BBS at Eglin, via the INMARSAT B. (Test file download times were: 8KB- 20 secs, 37KB- 2 mins 45 secs, and 45KB- 3 mins 19 secs).

MAGNAVOX MX 6060 PORTABLE SATELLITE TERMINAL

From there, they visited SRI International in San Francisco to learn new methodology used to upload/reprogram the AN/APR-39A(V)1 User Data Module (containing the MDS). This process uses an inexpensive RS-232/485 converter cable and the unclassified laptop software developed by SRI International under contract to the ARAT-PO.

Back at Eglin, ARAT-TA had obtained an AN/APR-39A(V)1 (programmed with OFP 023.9) and a MX-9848A Test Bench Set -- a configuration that replicates the RSDS installed on an aircraft. As the designated technicians for this multi- service deployed test, MSgts Lang and Rogers dry ran numerous tests to verify the satellite phone, satellite, and BBS set-up. After establishing that all was ready for the exercise, they coordinated with the US Navy in Norfolk, Virginia, and a date was set for their movement to Mayport, Florida to meet the USS Kennedy.

Thus, the stage was set for what was about to happen aboard the USS Kennedy. On 21 February 1996, the USS Kennedy (with our two MSgts aboard and enjoying their first night sleeping in a 'rack' to the melodic tunes of 60,000 pound aircraft being thrown off the bow and 40,000 pound aircraft arresting on the stern) set sail into the sunset.

On 22 February, as the USS Kennedy was under flight operations, they set up their portable satellite equipment (a total weight of 45 pounds including the carrying case) in five minutes. The compact satellite equipment and the RSDS were configured on the O-10 level (adjacent to the myriad of rotating and scanning radar antennas).

PORTABLE SATELLITE ANTENNA

After aligning the integrated Global Positioning System satellite phone antenna with the INMARSAT-B satellite they were able to dial 'home' to the BBS at Eglin AFB and download three files with geo-tailored MDSs. The MDSs were MDS026 (17KB, taking 6 mins 18 secs), 031 (18.3KB, taking 2 mins 15 secs) and, 034 (21.3KB, taking 2 mins 30 secs).

ESTABLISHING BBS CONNECTION

Each of the Army developed, executable MDS files self-extracted to reveal the appropriate pilot kneeboard sheets and pertinent notes for each MDS. MSgts Lang and Rogers used the same communication software protocol (PC-PLUS and 'Z' modem) that is the standard for the Multi-Service BBS.

On 23 February (after enjoying their first Navy shower--30 seconds on, 30 seconds off, 30 seconds on - then out), they moved the equipment to a different location aboard the USS Kennedy to verify that it was possible to access the satellite from all parts of the ship. The new position was portside aft near the carrier Fresnel Landing Lens.

ALTERNATE LOCATION OF PORTABLE SATELLITE ANTENNA

Uplinking to the satellite on a frequency of 1.6 GHz and downlinking at 1.5 GHz, they were able to download additional MDSs: 029 (size 15KB, taking 2 mins 20 secs), and 030 (size 4.3KB, taking 18 secs). They then uploaded MDS 029

and 031 (downloaded the previous day) to the RSDS; each took 1 min 25 secs, including verification.

MISSION DATA SET DOWNLOAD INTO A LAPTOP

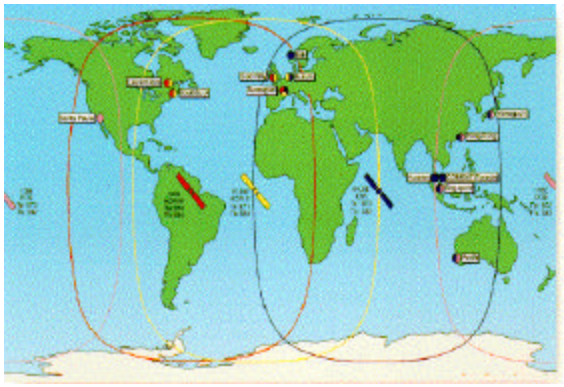
Additional data available from the BBS deals with other survivability equipment and their capabilities against specific threats e.g., AN/ALQ-144A(V)1/3, AN/AAR-47, and AN/APR-39(V)2 RSDS. Although this data is not formatted in a MDS structure for reprogramming, it allows users to ensure they have the most recent information that relates to areas of operation and systems' effectiveness. For example, changes in switch settings for the AN/ALQ-144A(V)1/3 Infrared Countermeasures Systems were loaded for worldwide dissemination as soon as they were 'blessed' by the PM-AEC in St. Louis.

To test the effectiveness of the BBS E-Mail function, ARAT-TA posted several questions to the MSEC BBS at Eglin that were received at sea, answered by MSgt Lang, and returned via the INMARSAT B. Such a capability allows Electronic Warfare Officers the ability to interrogate 'experts' on threat information, systems capabilities, problem areas that require assistance, and provides a way to pass real-time information.

All the download tests were completed at 2400 Baud, so the above download times appear somewhat long. 9600 Baud is the standard rate for the BBS, therefore actual rates will be considerably reduced. For the above download tests, the average cost per minute ranged between $3 to $6.00 -- an insignificant amount when one considers that prior to Desert Storm, data and reprogramming processes could easily take weeks/months to filter down to the units. Some MDSs were not fully optimized, because many times the tactical environment and operational tempo precluded CECOM EW fielding teams from having timely access to deployed aviation units. With the rapid and expansive fielding of OFP 023.9 for the AN/APR-39A(V)1, a reprogramming cable provided by ARAT-PO, and a little investment by the supported unit (any secure laptop/PC and STU-III), any user can enjoy the fruits of the reprogramming/information warfare highway.

For Army and sister service users, the question of global access arises. Access is indeed global, because four INMARSAT B

satellites provide full coverage of the Atlantic, Pacific and Indian Oceans.



INMARSAT B ORBITS

Connections are provided through such geographically diverse ground stations in France, Hong Kong, Norway, Australia, Japan, and the USA. The next question is, "Does this exercise and capability have relevance to present and future operations ?" Here again, the answer is yes. Looking back in recent combat history, Task Force 118 (now the 4-17TH CAV) was stationed aboard US Navy vessels in the Persian Gulf for three years (in Operation Prime Chance and Earnest Will) and again aboard the USS Nicholas during Desert Shield/Storm. TF118 encountered different threat emitters, depending upon who processed through their area of operations. The emitters covered everything from naval surface search, ship rendezvous radars, target acquisition, track, anti-aircraft artillery emitters, coastal emitters to airborne platforms.

In addition, TF160th regularly deployed (and still does) to ensure its aviators can go anywhere and anytime to complete their missions. The deployment of MH-47s, MH-60s and AH-6s (all with survivability equipment installed) aboard the USS America (CV-66) for the planned invasion of Haiti would have been easily supportable via the MSEC BBS and INMARSAT B.

Looking to the future, the USN and USMC have an important stake in the success of this connectivity. The USN (with HH-60Hs) and the USMC (with AH-1Ws, UH-1Ns, MV-22s, and CH-53s) are scheduled to get the AN/APR-39A(V)2 RSDS (the big brother/sister to the AN/APR-39A(V)1/3). At sea for considerable periods of time on Amphibious Assault type ships, they will have the need and the modus operandi to update MDSs, access other threat data and provide secure communication data back to 'homeplate'. At present, the US Navy is outfitting numerous major surface combatants (i.e., carriers, amphibious assault ships, amphibious transport docks, etc.) with permanent INMARSAT terminals. These terminals will provide satellite access for personal and military communications around-the-clock. In addition, USN Cyclone Patrol Craft (currently using AN/APR-39A(V)1) can also dial home for support.

The success of 'simplistic' and expeditious global communication channels to be able

to update or reprogram AEC systems is an important step that has other ramifications for the low-slow platforms. By their very nature, the reprogrammable EW equipment carried on these platforms must be small, compact, light-weight and maintain current "geo-specific" threat data files. From experience in all the services (even those with some of the most sophisticated and costly EW equipment) we know that too much data 'crammed' into the processor's memory can cause some processing and display ambiguities. Consequently, for the US Army, smaller has proven to be better through the use of this electronic medium. For the USAF, this field demonstration highlighted the deployability, accessibility and readiness that is now available 'immediately' to its deploying units in a bare base scenario.

Finally, we need to blow our horn a little in the way that all the services worked together on this successful demonstration. 'We' had USAF personnel downloading Army MDSs on a Navy ship. All to demonstrate 24 hour access to a Multi-Service Electronic Combat BBS, for Army, Navy, Air Force and Marine platforms via a civilian operated satellite.

... Meanwhile, back at the USS Kennedy, our two intrepid airmen (Lang and Rogers) enjoyed a job well done. As one reward, they got an opportunity to join an elite aviation club that most USAF personnel never get - a catapult shot from the bow of an attack carrier.

Author:

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Software Engineering Directorate computer display at the Northeastern Region, Old Crow convention, showed the unclassified wide world web services provided to the electronics warfare community by the ARAT project office.